

## NOTES ON TRIASSIC PLANTS FROM NEW MEXICO.

BY

WM. M. FONTAINE AND F. H. KNOWLTON.

(With Plates XXII-XXVI.)

In 1886 a small collection of fossil plants was made by Maj. J. W. Powell at the Copper Mines near Abiquiu, New Mexico, and during the past season (1889) the same locality was visited by Prof. F. H. Knowlton who obtained additional material. The plant impressions were referred to me by Prof. Lester F. Ward for determination, and sections of the wood obtained have been made and studied by Professor Knowlton.

### DESCRIPTION OF THE LOCALITY.

By F. H. KNOWLTON.

The little village of Abiquiu stands upon a bluff overlooking the valley of the Chama River, and is about 25 miles northwest of Espanola, the terminal point of the branch of the Denver and Rio Grande Railroad, and about 50 miles northwest of Santa Fé, New Mexico. The general topographic and geologic features of the surrounding country have been so thoroughly described by Dr. J. S. Newberry, who was attached as geologist to the "Exploring Expedition from Santa Fé, New Mexico, to the Junction of the Grand and Green Rivers" under Capt. I. N. Macomb, in 1859, that little remains to be added.

The copper mines which have been known and worked by the Mexicans for a very long time, are about 6 miles northeast of Abiquiu and about 1,000 feet above the valley of the Chama. After leaving the Chama, which on the north side at this point is characterized by a little lateral valley eroded from mostly whitish coarse sandstone probably of Tertiary age, we enter another valley, or rather almost a cañon, which has been cut through Triassic rocks. The sides of this cañon exhibit bands of variously colored sandstones, the colors being red, white, yellow or orange, and the strata being nearly horizontal.

At the top of the mountain a large eroded basin is entered from the southeast. This basin, which according to Newberry drains into the Chama Valley, is about  $1\frac{1}{2}$  miles from south to north and 1 mile from east to west, and is surrounded by a wall, in some places nearly vertical, between 500 and 600 feet high. This wall is composed at base of sandstones and marls about 200 feet in thickness, above which is a

stratum of reddish fine-grained sandstones, also about 200 feet in thickness, the whole being capped by a layer of coarse-grained, yellowish sandstones 150 feet or more in thickness.

In some places the second of the above-mentioned strata has the sandstone of a yellowish or nearly white color, and it is in this material on the eastern side that the old copper mines are located. There are but three openings visible at the present time. The openings are 5 or 6 feet square and descend at a slight angle, the deepest being only about 75 feet. Only one is branched, and none of them are braced up with timbers at the present time. At the time the mines were visited by Dr. Newberry they were braced up with heavy timbers, and there was evidence of quite an extensive series of tunnels. It is possible that the mines visited are not the same as those mentioned by Dr. Newberry, as they have been recently worked, and exhibit none of the evidences of great antiquity noticed by him, but these were the only mines known to the guide, who was a native of Abiquiu, and had worked in the mines. The copper occurs as a sulphide of copper and iron, and as iron carbonate, and is distributed through a layer hardly more than 4 feet in thickness. It has replaced the trunks of trees and various vegetable stems and fragments, and also occurs in concretions about and among the quartz pebbles.

Just above the openings of the mines occurs a layer of carbonaceous shale, about 8 inches in thickness, which contains fossil plants. The material splits very readily into thin laminae and is very fragile. The surface of the shale is covered with such a mass of vegetable impressions that it is with considerable difficulty that anything can be made out; but by removing a considerable quantity of the material a fairly clear display of the plants was obtained.

From the same white sandstone, about 10 feet above the shale holding the plant impressions, considerable fossil wood was obtained. One trunk, which was 2 feet 8 inches in diameter, was observed in place in the sandstone, and numerous pieces of greater or less size were scattered about. While only one trunk was actually found *in situ* there is every evidence to indicate that the loose pieces came from the immediate vicinity. The wood is fairly well preserved and, as the microscopical examination showed, retains the structure in a manner which allows its satisfactory study and determination.

The new copper mines, which were opened during the spring of 1889, are in the northwestern part of the basin. They are located in a white very coarse-grained sandstone which, as there exposed, forms the floor of the basin and is consequently several hundred feet lower than the old mines. The copper occurs in the form of wood or stems only. Some of the stems bear evidence of having been large but are now considerably disintegrated. The structure has almost entirely disappeared from these stems, but a carefully selected section shows traces of it to be still retained.

Associated with these stems are the casts of many large and small stems of *Equisetum*; but the matrix is by far too coarse and granular to successfully preserve delicate leaves or fronds.

#### DESCRIPTION OF THE SPECIES.

By WM. M. FONTAINE.

##### I.—*Plants of the lower horizon or from the new copper mines.*

*Equisetum Abiquiense* sp. nov. Fontaine. Plate XXII, fig. 1.

This is preserved in a coarse white sandstone. It is characterized by the considerable width of the ribs, their flatness, and the great number and distinctness of the scars left by the articulation of the leaves. The larger piece must have formed a part of a stem 6 inches in diameter.

This fossil, forming cast No. 1, is much like *Schizoneura planicostata*, Rogers spec., the *Calamites planicostatus* of the Richmond coal field, and may be the same plant. As, however, no impressions of *Schizoneura* have been found in this formation, and as the other fossil found with it is certainly an *Equisetum*, it seems best to regard this as an *Equisetum* also until portions more decisive of character are found. For convenience of reference it may be called *Equisetum Abiquiense*. Two specimens, internal casts.

*Equisetum Knowltoni* sp. nov. Fontaine. Plate XXIII, Figs. 2-4.

This cast is preserved in a fine grained white sandstone. The casts on their exterior are usually impregnated with malachite, the carbonaceous matter seeming to have been active in precipitating the copper from solution. These impressions evidently were formed by a plant very different from that yielding cast No. 1.

These casts are characterized by the possession of numerous very short internodes, very narrow prominent ribs, and by the entire absence of the scars of leaf-articulations. The shortest internodes are 1 centimeter in length, one specimen (Fig. 4) showing six of these. The longest are 22 millimeters in length. The widest ribs are 1 millimeter in breadth and the narrowest about one-third of a millimeter, and the average is about one-half of the same. In the narrowness of the ribs this plant resembles the internal casts of *Equisetum Rogersi* of the Richmond Coal Field, the impressions that were called *Calamites arcuaceus*. The persistent shortness of the internodes, however, is a feature which distinguishes this from the Virginia plant. It might be called *Equisetum Knowltoni*. Six specimens; internal casts.

##### II.—*Plants of the upper horizon or from the old copper mines.*

As Mr. Knowlton points out, the plants of this higher horizon are totally different from those lower down. I find among them none of the impressions of *Equiseta* that form all of the fossils of the lower horizon.

It must, however, be borne in mind that this difference may in part be due to the accidents of preservation, as the coarse sandstone of the new mine could not preserve imprints of leaves. No previous collector seems to have found fossils at the lower horizon. Dr. Newberry gives no imprints of *Equiseta* from the Abiquin Copper Mines, and the material collected by Major Powell in 1886, which I have examined, evidently comes from the higher horizon. The shale, however, which carries the impressions collected by Major Powell is more siliceous and indurated than that obtained by Mr. Knowlton, which may be due to the fact that it was got from a different place in the stratum. The following are the plants identified from this locality:

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| 1. <i>Zamites Powellii</i> sp. nov. Fontaine. | 5. <i>Palissya cone</i> ? (specimen 13). |
| 2. <i>Cheirolepis Munsteri</i> Schimp.        | 6. <i>Cycadites</i> ? (specimen 23).     |
| 3. <i>Zamites occidentalis</i> ? Newb.        | 7. <i>Ctenophyllum</i> ?                 |
| 4. <i>Palissya Braunii</i> ? Endl.            |  |

*Zamites Powellii* (Figs. 5-7) occurs as a great rarity among the specimens collected by Major Powell, but is the most common of the imprints found by Mr. Knowlton. It is nearest to *Zamites Feneonis* Brongn., among previous described plants, but does not seem to be identical with it and is probably new. It does not seem to have been found in the plants described by Newberry from Los Bronces and the copper mines near Abiquin. It has wider and longer leaflets than *Z. occidentalis* Newb., and they are more bluntly terminated than those of *Z. Feneonis* Brongn.

*Cheirolepis Munsteri* Schimp. is proportionally much less common among these plants than those collected by Major Powell, and the imprints are imperfectly preserved.

One specimen of *Zamites occidentalis*? Newb. was seen and it was too obscure to permit of a positive identification.

*Palissya Braunii*? Endl. occurs in several specimens. It is certainly a *Palissya* and seems to be very near *Palissya Braunii*, but the specimens are not well enough preserved and large enough to permit of a positive identification. It seems to be the same with the plant figured as *Palissya*? in Newberry's Geological Report of the Macomb Expedition, Plate VI, Fig. 10.

*Palissya cone*? This fossil, seen in only one specimen, is most probably the cone of a *Palissya*, and probably belongs to the species which has been doubtfully identified with *P. Braunii* Endl. This cone is much like that given by Newberry in his Report on the Geology of the Macomb Expedition, Plate V, Fig. 5. It is shorter and has longer scales than the one given by Schenk as the cone of *P. Braunii*. (See Foss. Flora der Grenzschiechten, tafel XII, Fig. 7.)

Specimen 13 is an obscure imprint, which seems to be a *Cycadites*. This is indicated by the narrow, stiff leaves, narrowed at base to a peduncle and by what seems to be a midrib in the leaves. It is not well enough preserved to be identified with certainty.

Several specimens show long, strap-shaped leaflets, which never possess either base or termination. They look much like *Otenophyllum grandifolium* of the older Mesozoic Richmond Coal Field of Virginia, but are not well enough preserved to be certainly made out. They may be fragments of Newberry's *Pterophyllum robustum*, found at Los Bronces, and this is apparently the same as *Otenophyllum grandifolium*.

These fossils from the copper mines near Abiquiu are not numerous enough and sufficiently well preserved to enable one to determine with positiveness the age of the strata which contain them. They, however, indicate that the beds are not older than the Rhetic.

#### FOSSIL WOOD FROM THE OLD COPPER MINES.

By F. H. KNOWLTON.

*Araucarioxylon Arizonicum* Knowlton\* is represented by seven pieces of wood which, as stated above, were obtained from sandstone about 10 feet above the shale containing fossil plants at the old copper mines. The material is not as perfectly preserved as that from which the species was described, but it is sufficiently clear to indicate that it is identical with it.

In transverse section the annual rings are found to consist of only three or four layers of tangentially compressed cells as in the type. The remaining cells are of nearly uniform size and possess thick walls.

The radial section is very obscure, and in only one or two limited areas is it possible to demonstrate the presence and outline of the punctations. They are arranged in a single longitudinal row in the center of the cell. No double row of punctations could be detected, but this condition was not of frequent occurrence in the type specimens. The medullary rays consist of relatively short cells as in the type.

In tangential section the medullary rays are observed to be in a single series of superposed cells, and range from one to twenty or more in number. The punctations that were described in the type specimens could not be detected in this material, and, indeed, a further examination of material from the type locality shows that these tangential punctations are not all uniformly present.

*Coniferous Wood?* As before stated the deposits of copper occur as displacements of vegetable stems, from which, in most cases, the structure has entirely disappeared. Sections were made from exceptionally well preserved specimens from the new copper mines, and these show the outlines of a few cells which are arranged in radial rows and separated by what must be medullary rays, although these latter are only imperfectly preserved. This seems to indicate that it was a solid stem, and from the general appearance it most probably represents a coniferous wood.

\* Knowlton in Proc. U. S. Nat. Mus., vol. xi, 1888, pp. 1-4, Pl. J.